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TECHNICAL REPORT
70-20-FL

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FACTORS AFFECTING THE QUALITY OF FREEZE-DRIED GREEN BEANS

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FOREWORD

Freeze-dried foods have been accepted by consumers due to their superior quality as compared with foods dried by conventional methods. Their use in the Military operational rations is increasing steadily and is expected to continue upward when the Armed Forces Feeding system shifts more towards convenience foods. Availability of freeze-dried fruits and vegetables such as peas is not assured all year round due to seasonal production and processing.

This work was undertaken to provide data concerning the development of dehydrated food items from frozen commercial products, thus making it possible to procure dehydrated fruits and vegetables needed for military rations at any time of the year.

This work was conducted under Project No. 1J6-62708-D553, Food Processing and Preservation Techniques.

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ABSTRACT

The effect of extended blanching, sulfiting and packaging on the quality of freeze-dried green beans prepared from commercially frozen products and stored for six months at 100°F. were investigated. Results indicated that acceptable freeze-dried green beans can be prepared from commercial frozen green beans by freeze-drying without any further treatments and packaging in tin cans under vacuum or nitrogen.

FACTORS AFFECTING THE QUALITY OF FREEZE-DRIED GREEN BEANS

Introduction

Freeze-dried foods are of great importance in meals where rapid rehydration is required such as in the quick serve meal. However, since the production season of fresh green beans is relatively short, procurement of freeze-dried green beans is closely related to and significantly affected by seasonal changes.

Information on the use of frozen instead of fresh green beans for the production of freeze-dried green beans is limited, incomplete and inconclusive in regard to the effect of thawing, refreezing, reblanching, and sulfiting on the quality of the finished product. Therefore, this work was carried out to determine the effect of such variables on the quality of freeze-dried green beans. Work of somewhat similar nature has been conducted on other vegetables. Pettit (1953) reported that green beans which had been frozen prior to heated-air dehydration were greatly superior in acceptability and rehydration characteristics to non-frozen beans. However, when peas are dehydrated by the prefreeze method they are not materially better than when not prefrozen. Moyer, et. al. (1959) stated that freezing and thawing increases slightly the drying rates of older peas. He also indicated that increasing the blanch increased the rehydration ratio. Rahman et. al. (1969) found that acceptable freeze-dried peas can be prepared from commercial individually quick frozen (IQF) peas by thawing, slitting, sulfiting, refreezing, freeze-drying and packaging in tin cans under vacuum or nitrogen. Rahman et. al. (1969) indicated that freeze-dried corn of a acceptable quality can be prepared by freeze-drying commercially frozen corn without any further treatments.

Experimental Procedures

Frozen cross-cut green beans were purchased from the local retail market. The green beans were thawed, divided into two lots and one lot blanched for 3 minutes in boiling water. This was an extended blanch (the commercially frozen green beans had been blanched prior to freezing) to assure the in-activation of the peroxidase enzyme before freeze-drying. The second lot was not blanched.

One-half of each lot was sulfited by dipping in solution of sodium metasulfite to yield approximately 500 ppm. All the lots were refrozen at -20°F. and then freeze-dried with a platen temperature of 120°F. for 16 hours.

Half of the freeze-dried green beans for each lot were packed in No. 2-$\frac{1}{2}$ tin cans under nitrogen and the other half under vacuum. Representative samples of each variable were stored at 70°F. and 100°F. for a period of 6 months.

Freeze-dried green beans were rehydrated by placing replicate samples in boiling water (approximately 4-1 ratio water to green beans by weight) and allowing to stand for 12 minutes in a covered pan. Additional heat was not applied. The texture of rehydrated green beans was measured with the Lee-Kramer shear press immediately after rehydration using the regular cell with 30 seconds down stroke. Rehydration ratio was determined by dividing the rehydrated weight of the green beans by the dry weight.

Technological panel evaluations for flavor, texture and color were conducted by 10 trained judges using a 9-point scale (1 = extremely poor; 9 = excellent). Overall acceptability of the green beans was determined by a consumer panel of 32 judges using a 9-point Hedonic scale (1 = dislike extremely; 9 = like extremely).

Results and Discussion

Results of the texture as measured by the shear press, rehydration ratios, technological panel ratings and consumer panel ratings, are shown in Tables 1, 2, 3 and 4, respectively. Analysis of variance of these results are shown in Table 5.

Significant differences in texture due to treatments were exhibited when the green beans were stored for 3 months at 70 or 100°F. Although unblanched green beans generally showed tougher texture, significantly higher differences were found only in samples which were unblanched, with or without SO_2 and packed under vacuum. They were significantly higher than the rest. However, these differences disappeared at longer storage periods since no apparent difference between the results of treatments were evident after 6 months of storage at 70 or 100°F.

The rehydration ratio of blanched green beans was somewhat higher than for the unblanched product regardless of time and temperature of storage. However, no treatment can be singled out which consistently exhibited significantly higher rehydration ratio throughout these studies. Results of the technological ratings indicate no important difference between the various treatments. The consumer panel ratings showed marked differences between specific treatments such as that for green beans blanched, treated with SO_2 packed under nitrogen and stored for 6 months at 70°F. which received significantly lower ratings than the rest. However, no significant difference can be shown between samples stored for 6 months at 100°F. The oxygen analysis in the cans for green beans packed under vacuum ranged from 0.6 to 1.5% and 2.7 to 4.4% for cans packed under nitrogen. However, these differences did not affect the quality as indicated by the technological as well as the consumer panel ratings for green beans stored for 6 months at 100°F.

Conclusions

Freeze-dried green beans of acceptable quality meeting the military requirements of storage stability for 6 months at 100°F can be prepared from commercially frozen green beans by freeze-drying without any further treatments and packaging in tin cans under vacuum or nitrogen.

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Table 1. Texture of Rehydrated Green Beans as Affected by Treatments and Storage Temperature as measured by the Lee-Kramer Shear Press

Treatments	Initial	Storage Temperature 70° F.		Storage Temperature 100° F.	
		3 mo.	6 mo.	3 mo.	6 mo.
	Lbs	Lbs	Lbs	Lbs	Lbs
Blanched, SO_2, N_2	116	129	135	140	139
Blanched, SO_2, Vac	118	141	131	148	131
Blanched, N_2	114	130	124	143	139
Blanched, Vac	114	146	139	122	141
SO_2, N_2	149	178	144	153	158
SO_2, Vac	148	190	159	218	156
N_2	164	174	172	183	165
Vac	179	190	164	188	154

Table 2. Rehydration Ratios (Rehydrated and Dry Weight) of Freeze-Dried Green Beans as Affected by Treatments and Storage Temperatures

Treatments	Initial	Storage Temperature 70°F.		Storage Temperature 100°F.	
		3 mo.	6 mo.	3 mo.	6 mo.
Blanched, SO_2, N_2	15.36	13.20	13.38	12.83	13.36
Blanched, SO_2, Vac	15.53	14.30	13.91	12.85	12.99
Blanched, N_2	15.66	13.61	12.74	12.69	12.79
Blanched, Vac	15.73	12.95	12.52	13.62	13.33
SO_2, N_2	14.10	13.10	13.54	11.43	11.92
SO_2, Vac	14.20	11.98	11.60	11.27	11.82
N_2	12.90	10.73	10.38	10.77	10.81
Vac	12.70	11.65	10.50	10.91	10.91

Table 3. Average Ratings (Technological Panel) of Rehydrated Green Beans as Affected by Treatments and Storage Temperature

Treatments	Initial	Storage Temperature 70° F.		Storage Temperature 100° F.	
		3 mo.	6 mo.	3 mo.	6 mo.
Blanched, SO_2, N_2	5.9	5.7	5.4	5.2	5.7
Blanched, SO_2, Vac	5.3	4.7	5.2	5.2	5.8
Blanched, N_2	6.1	5.8	5.4	5.0	5.5
Blanched, Vac	6.3	5.8	5.2	5.3	5.5
SO_2, N_2	6.4	5.1	5.2	5.7	5.7
SO_2, Vac	6.3	5.3	5.1	5.8	5.8
N_2	6.4	5.4	5.0	5.3	5.2
Vac	6.5	4.7	5.5	5.1	5.6

Table 4. Average Acceptance Ratings (Consumer Panel) of Rehydrated Green Beans as Affected by Treatments and Storage Temperature

Treatments	Initial	Storage Temperature 70° F.		Storage Temperature 100° F.	
		3 mo.	6 mo.	3 mo.	6 mo.
Blanched, SO_2, N_2	6.2	5.6	5.2	4.9	5.5
Blanched, SO_2, Vac	6.1	5.8	5.9	5.3	5.5
Blanched, N_2	5.9	5.7	5.9	5.0	5.4
Blanched, Vac	5.9	5.9	6.0	5.4	5.6
SO_2, N_2	5.9	5.8	6.4	5.6	5.5
SO_2, Vac	5.9	5.8	6.1	5.3	5.1
N_2	5.6	5.8	6.6	5.4	5.7
Vac	5.5	5.6	6.3	6.0	5.6

Table 5. Analysis of Variance Results

Factor	Technological Panel Rating	Consumer Panel Rating	Texture Shear Press	Rehydration Ratio
Treatments	N.S.	*	*	*
Temperature	N.S.	*	N.S.	N.S.
Time	N.S.	*	*	N.S.
Time x Temperature	N.S.	*	N.S.	*

* = $P > 0.05$ N.S. = Not significant at $P > 0.05$

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The effect of extended blanching, sulfiting and packaging on the quality of freeze-dried green beans prepared from commercially frozen products and stored for six months at 100°F. were investigated. Results indicated that acceptable freeze-dried green beans can be prepared from commercial frozen green beans by freeze drying without any further treatments and packaging in tin cans under vacuum or nitrogen.

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Frozen foods	9		7		7	
Green beans	9		7,4		7	
Military rations	4				4	
Blanching	8		6			
Sulfiting	8		6			
Packaging						
Quality			7		7	
Thawing	8					
Freezing	8					
Nitrogen	5					
Vacuum	5					
Acceptability					7	

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